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the lamp chimney and the straight end of the pipe under the bed clothes. This gives a good heat and soon warms the patient. We worked very hard over this man but we could not save him. The little boy made a splendid recovery. After the man died I told his wife that the mattress must be burned. She objected very strenuously. "Why," she said, "I paid \$4 for that mattress only a few months ago." I explained that if she used it again it might cost her hundreds of dollars. After a great deal of talking and after explaining to her the dangers of typhoid, she decided to burn the mattress but grieved greatly over the loss.

THE ADMINISTRATION OF MEDICINES

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THE ADMINISTRATION OF ALKALIES AND ALKALINE SALTS

The remedies usually classified in this group are such substances as the salts of sodium, like sodium bicarbonate, the salts of potassium and magnesium and the salts of calcium such as lime water and others.

Any of these salts may be given for their local effect or for absorption. Thus, sodium bicarbonate may be given to combine with the excessive acid in the stomach, or it may be given for absorption, in diabetes for instance, to neutralize the acids circulating in the blood which may be threatening diabetic coma. Calcium salts, too, may be given in the form of lime water merely as an antacid, or in the form of calcium lactate for absorption, to increase the coagulability of the blood.

The method of administration of such substances varies with the desired effect. When only a local effect in the stomach is desired, the alkalies and their salts should be given so as to avoid absorption; thereby increasing the chemical combination of alkali and acid in the stomach. To produce this effect the alkalies should be given immediately after meals in a small quantity of an albuminous fluid like milk. In such a fluid very little dissociation of the salt will take place, the absorption will be minimized, and since after meals there is a large amount of acid present in the stomach it will readily combine with the alkalies or their salts.

When, however, these salts are given for absorption it is essential that they be readily dissociated into their ions. In this way absorption and subsequent chemical action is enhanced. This effect will be

produced more readily if the alkaline salts are given before or between meals in a large quantity (in about one or two tumblerfuls) of water, since water is the best dissociant.

While discussing the alkalies it is interesting to note an error which is often made in the preparation of sterile solutions of sodium bicarbonate, for intravenous use. In most hospitals these solutions are prepared by first dissolving the sodium bicarbonate in distilled water and then sterilizing the solution in the autoclave. The sodium bicarbonate, however, becomes decomposed when it is brought to the boiling point so that such a sterile solution is relatively inactive as regards the sodium bicarbonate. It is better to prepare the necessary quantities of sodium bicarbonate in small packages which should then be sterilized by dry heat of 60°C. on three successive days. The sodium bicarbonate can then be added to the necessary amount of sterile, distilled water at the time the solution is needed.

THE ADMINISTRATION OF INORGANIC SALTS

The remedies usually grouped under this heading are the saline cathartics and the metallic salts.¹ Since a different effect is desired from each of these groups, we shall discuss their administration separately.

Saline Cathartics. The saline cathartics are given to induce frequent, watery movements of the bowels (cathartic action), or to increase the flow of urine ((diuretic action). The method of giving the salts will vary according to whether we desire the first or the second of these effects. To produce catharsis we should try to avoid absorption of the salt, while for diuretic action we should try to increase absorption.

We can classify all salt solutions (no matter what salt they contain) in the following way:

(1) *Isotonic*—containing the same percentage as the blood. (2) *Hypertonic*—containing a greater percentage than the blood. (3) *Hypotonic*—containing a smaller percentage than the blood.

For practical purposes we shall consider only the hypertonic and hypotonic solutions.

The effects of hypertonic and hypotonic will differ only in that the hypotonic solution will increase the flow of urine more. The method of production of the effect, however, is different.

Let us consider for a moment what happens to any of the inorganic salts after they enter the stomach or intestines. When the salts are given in a concentrated form, so that a hypertonic solution is formed, the salt will withdraw fluid from the intestines by the force of osmosis

¹ See author's *Materia Medica for Nurses* for salt action and saline cathartics.

and thus indirectly from the tissues, until the solution becomes isotonic. The intestines now contain an excessive amount of fluid which distends them, in this way causing peristalsis and frequent watery movements of the bowels. Since the hypertonic solution is relatively concentrated, there is very little absorption of the salt and therefore very little diuresis can occur.

When, however, the salts are given in a large quantity of a fluid such as water, so that a hypotonic solution is formed, the solution serves only to distend the intestine and cause movements of the bowels. In such a solution, however, since it is very dilute, there will be considerable dissociation of the salt (according to principles laid down in a previous article) and therefore considerable absorption. The salt will then increase the flow of urine as it is excreted by the kidneys.

From the foregoing principles we can readily see that *salts, when given only for their cathartic effect should be given concentrated*, that is, in as small a quantity of fluid as the patient can palatably take, best in the morning when the stomach is empty; thus aiding osmosis and lessening dissociation and absorption. Fluid preparations of the salts should be given concentrated, without any water added.

When salts are given to increase the flow of urine, in addition to their cathartic action they should be given as a hypotonic solution, *in a large quantity of water* (in about one or two tumblerfuls in the morning on an empty stomach). In this way the dissociation and absorption of the salt is enhanced, and therefore its diuretic action. Only part of the salt, however, will be absorbed, but a sufficient quantity to produce diuresis.

METALLIC SALTS

The salts of the various metals are rarely given to produce a general effect after absorption, with the exception of the salts of mercury, iron, arsenic and lead. They are principally given for their local, astringent effect on mucous membranes.

It is well known that the metallic salts dissociate rapidly into their ions and they should therefore be readily absorbed; but we know that they are practically not absorbed at all. This is due to the fact that as soon as the metallic salts dissociate into their ions, the metal ions combine at once with the albumins of whatever cells they come in contact. This chemical combination, if it takes place to any degree, will injure (irritate) the cells. This irritation is frequently seen in the symptoms of metallic poisoning, vomiting, diarrhoea, etc. The albuminate of the metal formed by the combination of metal and cell is not absorbed unless this substance is soluble in the excess of albuminous fluid in

which the cells of the body are continually bathed. Some compounds of albumin and metal, such as compounds of mercury, iron, arsenic, lead, etc., are soluble in an excess of albumin and they are then absorbed. Most metallic albumin compounds, however, are absorbed to a very slight degree if at all.

In administering any of the metallic salts, whether they be given for their local or general effect we should only try to avoid their injurious (irritating) effect upon the cells. This is best accomplished by giving these substances in a fluid like milk, the albumin of which readily combines with the metal and lessens the injury to the cells of the mucous membranes, usually produced by the rapid combination with the metal. Many albuminous preparations such as argyrol, protargol, etc., are on the market and have been found better than the ordinary silver preparations for this reason. In giving preparations like mercury, iron or arsenic salts, which are readily absorbed, it is perhaps better to give them in a larger quantity of milk so as to increase absorption.

The administration of metallic salts in milk both for local and general effects paradoxically accomplishes two different purposes. Practically only those metallic salts are given for local effects, that are not readily absorbed. Giving such preparations in milk avoids the injury (irritation) to the cells, produced by the combination of metal and cell albumin, since the metal reaches the cell already combined with the albumin of the milk. In the milk, too, very little dissociation takes place and therefore the absorption of the metal is lessened.

When substances like mercury or arsenic salts which are readily absorbed, are given in milk the combination of the metals with the albumin of the milk are substances which are readily dissolved in the albuminous fluids of the cells and tissues and are therefore more easily absorbed. The absorption can possibly be increased by giving the salt in a larger quantity of milk.

(To be continued)